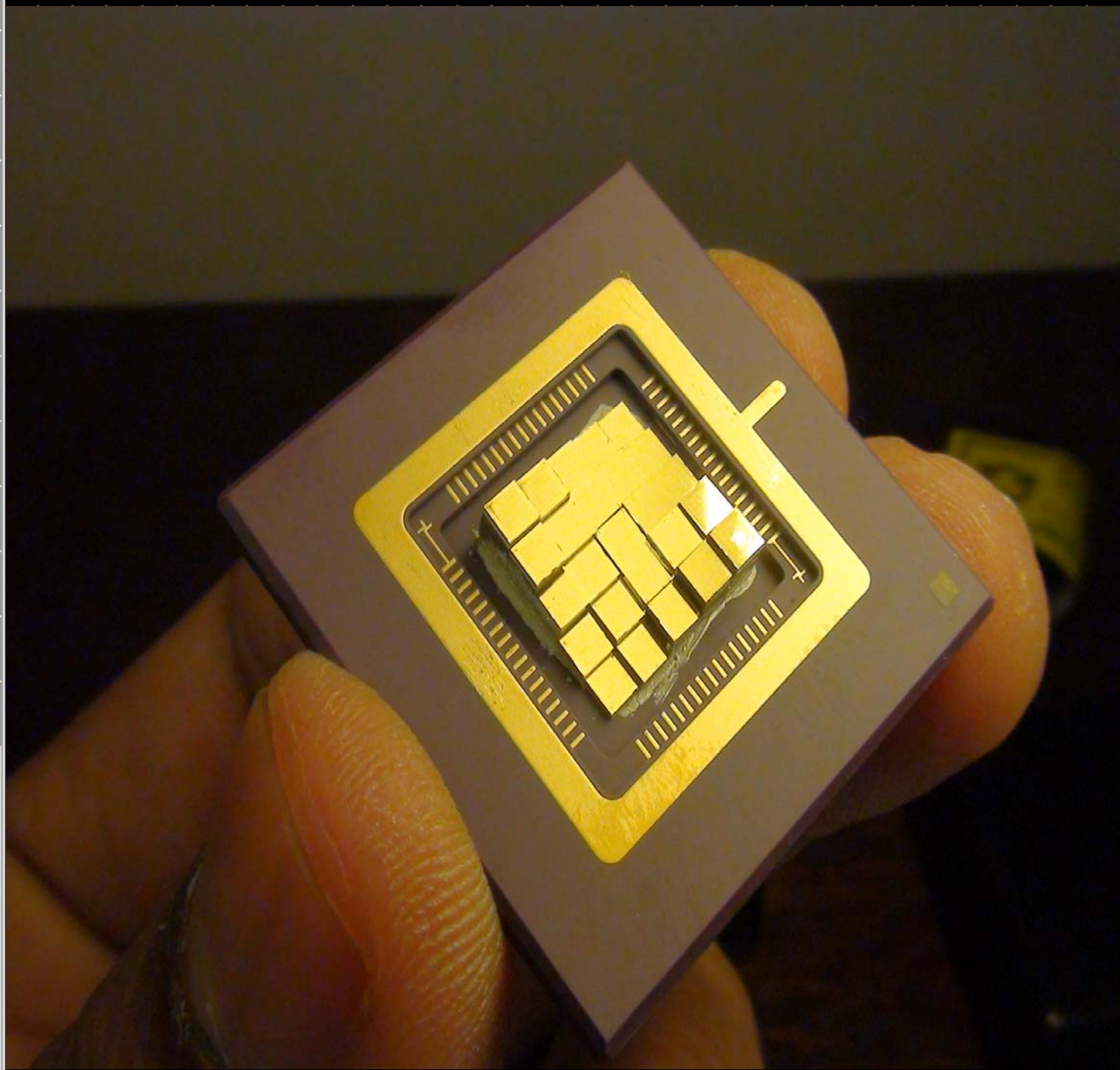




RESEARCH CENTRE FOR INTEGRATED MICROSYSTEMS (RCIM) REPORT

January 1, 2008 – December 31, 2008

Department of Electrical & Computer Engineering
University of Windsor



Director's Report for 2008

I am delighted to present the annual report of the Research Centre for Integrated Microsystems (RCIM), within the Department of Electrical and Computer Engineering, in the Faculty of Engineering at the University of Windsor. RCIM was established in January 2000 with an extensive financial and support encouragements from the former President, Ross Paul, and the former Provost and Vice President Academic, Professor Neil Gold and Dr. Graham Reader, the Dean of Engineering to conduct leading edge research, develop collaborative partnerships and train highly qualified graduate students in various areas of integrated Microsystems with applications in the field of digital signal processing, communication, automotive electronics few to mention. RCIM currently has 12 faculty members, 18 Ph.D. students and 27 M.A.Sc. students who are actively pursuing research in this facilities.

In 2008 RCIM faculty members graduated 12 MA.Sc. students. During the same year, our members received more than \$1,480,000 in grants and contracts and the results from their research works generated 48 papers published in premier Refereed Journals and top tier Refereed Conferences. Also, RCIM members delivered 26 research seminars during 2008 and our members were active in organizing various international conferences including: IEEE-EIT, IEEE-ICECS, and IEEE-MWSCAS few to mention.

On behalf of the RCIM faculty and student members I would like to express our sincere thanks for the continued support we have been receiving from the President, Dr. Alan Wildeman, Vice-President Research, Dr. Ranjana Bird, and the Dean of Engineering, Dr. Graham Reader of the University of Windsor. The support and encouragement received from Dr. Sid-Ahmed, Head of the Department of Electrical and Computer Engineering is also very much appreciated. Finally, we are especially thankful to CMC Microsystems for providing RCIM with multi-million dollar state-of-the-art facilities allowing us to design advanced integrated Microsystems and for subsidizing our IC fabrication costs.

Majid Ahmadi, Ph.D., C.Eng., FIET, FIEEE

Director of RCIM

University Professor

RCIM Areas of Specialization

The Research Center for Integrated Microsystems within the Department of Electrical and Computer Engineering in the Faculty of Engineering at the University of Windsor is carrying out leading edge research, in the following areas:

1. MICROELECTRONIC, including:

- High Speed DSP System
- Computer Arithmetic
- Encryption
- Testing of Mixed Signal Integrated Circuits
- Field Programmable Chips and Systems
- CMOS and Nanoelectronic circuits design

2. MICROELECTROMECHANICAL SYSTEMS (MEMS), including:

- Sensors and Filters
- Capacitive Microphones and 3-D Acoustical Sensing
- Electromagnetic Microactuators
- Acousto-Magnetic Transducers
- Optical Switching MEMS
- Automotive Sensors
- Customs MEMS Sockets
- Micro power Generators
- Atomic Force Microscopy
- MEMS RADAR

3. Digital Signal Processing and Communication, including:

- Algorithms
- Massively Parallel Arrays and Special Architects
- Computer Vision and Image Processing
- Pattern Recognition and Document Analysis
- Network Security Management
- Network Management

These projects vary from fundamental pre-competitive research to mission-oriented research, technology transfer and prototype development. We are particularly interested in areas requiring advanced signal processing systems embedded in complex integrated Microsystems.

I. RCIM MEMBERS

(A) Faculty Members:

Twelve professors in Electrical and Computer Engineering carry out research and supervise graduate students as members of the Research Centre for Integrated Microsystems. The day-to-day operation of the Center is administered by the coordinator of the RCIM, who provides training for new graduate students on how to use the facilities, as well as maintaining the hardware and CAD tools used by the RCIM members.

1. Dr. Majid Ahmadi, Professor (Director, RCIM)
2. Dr. Shervin Erfani, Professor
3. Dr. Chunhong Chen, Professor
4. Dr. Esam Abdel-Raheem, Associate Professor
5. Dr. Sazzadur Chowdhury, Associate Professor
6. Dr. Roberto Muscedere, Assistant Professor
7. Dr. Mohammed Khalid, Associate Professor
8. Dr. Huapeng Wu, Associate Professor
9. Dr. Mitra Mirhassani, Assistant Professor
10. Dr. Rashid Rashidzadeh (Adjunct Assistant Professor and RCIM Coordinator)
11. Dr. William C. Miller (RCIM Director Emeritus)
12. Dr. Stephen O’Leary, Professor

(B) Student Members:

RCIM has a strong track record of developing outstanding graduate students. Our students have been very competitive in the private sector and in admission to Ph.D. programs at major universities.

❖ **RCIM Students Graduated in 2008**

First name	Surname	Program	Supervisor	Thesis
Carol-Lynn	Deck	M.A.Sc..	Dr. R. Gaspar & Dr. M. Ahmadi	Variability Analysis of Engine Idle Vibration
Mohammed	Berhea	M.A.Sc.	Dr. C. Chen	Protocol-level performance analysis and implementation for anti-collision protocols in RFID systems
Bingxi	Li	M.A.Sc.	Dr. C. Chen	Design Methodology for Electron-Trap Memory Cells
Liao	Junsong	M.A.Sc.	Dr. M. Khalid & Dr. K. Tepe	FPGA implementation of a Wireless Sensor Network
Omar	Al Rayahi	M.A.Sc.	Dr. M. Khalid	A CAD Tool for Synthesizing Variants of Altera NIOS II Softcore Processor
Hongmei	Zhong	M.A.Sc.	Dr. E. Abdel-Raheem & Dr. M. Khalid	Implementations of low-power two channel PR QMF Banks using CSD Coefficients
Karl	Leboeuf	M.A.Sc.	Dr. R. Muscedere	A Versatile, Scalable, and Open Memory Architecture in CMOS 0.18 μm
Neil	Scott	M.A.Sc.	Dr. R. Muscedere	Development of a low cost, high speed machine vision system for pill inspection
Anthony	Karloff	M.A.Sc.	Dr. R. Muscedere	Development of a low cost, high speed machine vision system for pill inspection
Paresh	Bharkhada	M.A.Sc.	Dr. H.Wu & Dr. R. Muscedere	Fixed-Width Multi-Level Recursive Multipliers & Their FPGA/ASIC Implementation
Jose	Martines-Quijada	M.A.Sc.	Dr. S. Chowdhury	Bio-Mechanically Driven MEMS Power Generator for Implantable Medical Devices
Liton	Ghosh	M.A.Sc.	Dr. S. Chowdhury	Accurate Modeling of Load-Deflection Characteristics of AFM Microcantilevers Under Electrostatic Actuation

❖ **Current RCIM Students**

First name	Surname	Program	Supervisor	Thesis Title
David	Li	Ph.D.	Dr. E. Abdel-Raheem	Low power Efficient Design of H.264/AVC
Mohammed	Islam	Ph.D.	Dr. M. Ahmadi & Dr.M.A. Sid-Ahmed	Computer Vision for Quality Process Control Application
Mahzad	Azarmehr	Ph.D.	Dr. M. Ahmadi	DSP Processor Based on Multi-Dimensional Logarithmic Number System
Peng	Chang	M.A.Sc.	Dr. M. Ahmadi	A Low Power Digital Multiplier Design
Iman	Makaremi	Ph.D.	Dr. M. Ahmadi	Application of Hidden Markov Model in Word Recognition
Farhad	Hajaliasgari	Ph.D.	Dr. J. Wu & Dr. M. Ahmadi	Power Management and Leakage Power Reduction Methods in Deep Sub-Micron Nodes
Golnar	Khodabandehloo	Ph.D.	Dr. Ahmadi & Dr. M. Mirhassani	Low-Power, Area Efficient Arithmetic Circuits with CVNS
Amir Hossein	Nabatchian	Ph.D	Dr. M. Ahmadi & Dr. E. Abdel-Raheem)	On Human Face Recognition
Ashkan	Hosseinzadeh Namin	Ph.D.	Dr. M.Ahmadi & Dr. H.Wu	High-Speed Word-Level Finite Field Multipliers in F2m
Mohammadali	Sharifan	M.A.Sc.	Dr. H. Wu	A New Approach in Building Parallel Finite Field Multipliers
Ali	Shahabi	M.A.Sc.	Dr. H. Wu	TBA
Saif	Rahman	M.A.Sc.	Dr. H. Wu	Improved Bluetooth Key Exchange Using Unbalanced RSA
Karl	Leboeuf	Ph.D.	Drs. R. Muscedere & Dr. M. Ahmadi	Development of a low cost, high speed machine vision system for pill inspection
Paresh	Bharkhada	M.A.Sc.	Dr. H. Wu	Fixed Width Recursive Multipliers and their Hardware Implementations
Carl	Chute	M.A.Sc.	Dr. R. Muscedere	TBA
Stephen	Fox	M.A.Sc..	Dr. R. Muscedere	TBA
Sam	Farrokhi	Ph.D.	Dr. R. Muscedere	TBA
Gopalakrishnan	Puthucode	Ph.D.	Dr. C. Chen	TBA
Guoqing	Deng	Ph.D.	Dr. C. Chen	TBA

Suzana	Farzeen	MASc	Dr. C. Chen	TBA
Shi-Yi	Wong	MASc	Dr. C. Chen	CMOS 90nm Low-Power Rectifier Design for RFID Tags
Ananth	Mocherla	MASc	Dr. C. Chen	TBA
Mosaddequr	Rahman	Postdoctoral	Dr. S. Chowdhury	Investigation of electrostatically Actuated MEMS Transducers
Ahmad	Sinjari	Ph.D.	Dr. S. Chowdhury	Design of MEMS Radar For Automotive Collision Avoidance
Lal	Sundeeep	M.A.Sc	Dr. S. Chowdhury	Algorithm development for a MEMS radar
Naila	Syed	M.A.Sc.	Dr. S. Chowdhury	Design of a capacitive readout circuit
Erfan	Baghani	Ph. D.	Dr. S. O’Leary	TBA
Farida	Orapunt	Ph. D.	Dr. S. O’Leary	TBA
Wei	Lu	M. A. Sc.	Dr. S. O’Leary	Models for the optical dispersion relations of crystalline and disordered semiconductors
Jasmin	Thevaril	Ph. D.	Dr. S. O’Leary	TBA
Shaun	Zia	M. Eng.	Dr. S. O’Leary	An investigation of an in-plane bulk titanium microneedle for transdermal drug delivery
Mike	Brugge	MASc	Dr. M. Khalid	Design and evaluation of a parameterizable NoC router for FPGAs
Thuan	Le	MASc	Dr. M. Khalid	Implementation and Evaluation of an NoC Architecture for FPGAs
Nabih	Jaber	M.A.Sc.	Dr. E. Abdel Raheem & Dr. K. Tepe	Performance Enhancement of the OFDM-Based DSRC System Using Frequency-Domain MAP Equalization and Soft-Output Demappers
Fang	Chen	Ph.D.	Dr. S. Erfani	Design of an Enhanced Wideband Continuous-Time Sigma-Delta Analog-to-Digital Converter

Graduate Student Summary

During 2008 RCIM faculty members supervised 27 M.A.Sc. students and 18 Doctoral candidates. Over 70% of RCIM graduate students were recipients of various scholarships from NSERC, OGS, and the University of Windsor.

III. PROFESSIONAL ACTIVITIES of RCIM FACULTY MEMBERS

Dr. M. Ahmadi:

- Program Co-Chair for the ICCITT'2008, November, 2008, Bousan, Korea
- Member of IEEE-CAS Society Neural Network Committee
- Regional Editor, Journal of Circuits, Systems and Computer
- Associate Editor for Pattern Recognition Journal
- Member of the Steering Committee for the IEEE Midwest Symposium on Circuits and Systems

Dr. M. Khalid:

- Reviewer for ACM Transactions on Reconfigurable Technology and Systems
- Reviewer for IEEE Trans. on CAD, IEEE Trans. on VLSI and several IEEE sponsored conferences
- Reviewer for Journal of Circuits, Systems and Computers, published by World Scientific
- Panel Chair during 2008-2009 Ontario Graduate Scholarship (OGS) competition
- Reviewer for Canada Foundation for Innovation (CFI)
- Reviewer for Natural Sciences and Engineering Research Council (NSERC)
- Reviewer for Research Grants Council of Hong Kong

Dr. E. Abdel-Raheem:

- Reviewer for ICASSP '08.

- Editorial Board Member, IET (formerly IEE) Signal Processing,
- Associate Editor, Canadian J. Elec. & Comp. Eng. (CJECE)

Dr. S. O'Leary:

- Reviewer for grant proposals funded by NSERC
- Reviewer for grant proposals funded by Sharcnet
- Reviewer for Journal of Thin Solid Films
- Reviewer for Journal of Journal of Non-Crystalline Solids
- Reviewer for Journal of Journal of Applied Physics Letters
- Reviewer for Journal of Journal of IET Communications

Dr. S. Chowdhury :

- Reviewer, Elsevier, Communications in Nonlinear Science and Numerical Simulations
- Reviewer, IEEE Sensors Journal
- Reviewer, IEEE Transactions on Circuits and Systems I
- Reviewer, Journal of Nanotechnology, Institute of Physics Publishing, Dirac House, Temple Back, Bristol, UK
- Reviewer, Journal of Physics D: Applied Physics, Institute of Physics Publishing, Dirac House, Temple Back, Bristol, UK
- Reviewer, Journal of Micromechanics and Microengineering, Institute of Physics Publishing, Dirac House, Temple Back, Bristol, UK

Dr. C. Chen:

- Reviewer for a 2007 NSERC discovery grant proposal as well as many international journals and conferences

Dr. S. Erfani:

- Member of Steering Committee, IEEE Midwest Symposium on Circuits and Systems
- Technical Advisory Board member, Journal of Network and Systems Management

Dr. R. Rashidzadeh:

- Reviewer for IEEE International Conference on Electronics, Circuits, and Systems 2008.

- Chair of Circuit and Systems Session, 21st Canadian Conference on Electrical and Computer Engineering (CCECE 2008).

I. SCHOLARY ACTIVITIES AND PUBLICATIONS

(a) Refereed Journal Publications

1. A. H. Namin, H. Wu, M. Ahmadi, "A New Finite Field Multiplier Using Redundant Representation", *IEEE Transactions on Computers*, vol.57, no.5, May 2008, pp. 716-720.
2. M. Mirhassani, M. Ahmadi, G.A. Jullien "Low-Power Mixed Signal CVNS Based 64-Bit Adder for Media Signal Processing" *IEEE Trans. On VLSI*, vol.16, no.9, Sept. 2008, pp. 1141-1150.
3. M. Mirhassani, M. Ahmadi, G.A. Jullien "Robust Low- Sensitivity Adaline Neuron Based on Continuous Valued Number System " *Journal of Analog Integrated Circuits and Signal Processing*. vol. 56, 2008, pp. 223-231.
4. F. Chen, T. Kuendiger, S. Erfani, M.Ahmadi "Design of a Wideband low-power Continuous -Time $\Sigma\Delta$ Modulator in 90 nm CMOS Technology," *Journal of Analog Integrated Circuits and Signal Processing*, vol. 54, no. 3, March 2008, pp. 187-199.
5. Songtao Huang, M. Ahmadi, M.A. Sid-Ahmed "A Hidden Markov Model Based Character Extraction Method" *Pattern Recognition*, vol. 41, 2008, pp. 2890-2900.
6. Rashid Rashidzadeh, R. Muscedere, M. Ahmadi and W. C. Miller, "A Delay Generation Technique for," *IEEE Trans. Instrumentation and Measurement*, vol. 58, no. 7, July 2009, pp. 2245 – 2252.
7. A. Mirzaei, M. Rahmati, M. Ahmadi "A New Method for Hierarchical Clustering Combination" *An International Journal of Intelligent Data Analysis*, vol. 12, no.6, 2008, pp. 549-571.
8. A. H. Namin, H. Wu, M. Ahmadi "A High Speed Word Level Finite Field Multiplier in F_{2^m} Using Redundant Representation" *Accepted for publication in IEEE Transactions on Very Large Scale Integration*, Acceptance on July 2008.
9. C. Chen and Y. Mao, "A Statistical Reliability Model for Single-Electron Threshold Logic," *IEEE Transactions on Electron Devices (TED)*, vol. 55, no. 6, June 2008, pp. 1547-1553.
10. J. Tong, M. Khalid, "Profiling Tools for FPGA-Based Embedded Systems: Survey and Quantitative Comparison," *Journal of Computers, Academy Publisher*, vol. 3, no. 6, June 2008, pp. 1-14.

11. Y. Xu, M. Khalid, "A Fast and Effective Timing-Driven Placement Tool for FPGAs, *Journal of Circuits, Systems and Computers*," *World Scientific*, vol. 17, no. 4, August 2008, pp. 663-673.
12. K. Banovic, E. Abdel-Raheem, M. Khalid, "Computationally Efficient Methods for Blind Decision Feedback Equalization of QAM Signals," *AEU International Journal of Electronics and Communication*, vol. 62, no. 5, May 2008, pp. 474-485.
13. S.K. O'Leary, B.E. Foutz, M.S. Shur, and L.F. Eastman, "The sensitivity of the electron transport within bulk wurtzite indium nitride to variations in the crystal temperature, the doping concentration, and the non-parabolicity coefficient: An updated Monte Carlo analysis," *Journal of Materials Science: Materials in Electronics*, published online April 29, 2009.
14. F. Orapunt and S.K. O'Leary, "A quantitative characterization of the optical absorption spectrum associated with hydrogenated amorphous silicon", *Journal of Materials Science: Materials in Electronics*, published online December 13, 2008.
15. F. Orapunt and S.K. O'Leary, "Optical transitions and the mobility edge in amorphous semiconductors: A joint density of states analysis," *Journal of Applied Physics*, vol. 104, 2008, pp. 1-14.
16. H. Abdulhamid, K. Tepe, and E. Abdel-Raheem, "Iterative Tracking Techniques for 5.9 GHz DSRC Applications," *Research Lett. in Comm.*, Hindawi, 2008, available online via www.hindawi.com/journals/rlc
17. K. Banovic, E. Abdel-Raheem, and M. Khalid, "Computationally-Efficient Methods for Blind Decision Feedback Equalization for QAM Signals," *Int. Journal. of Electronics & Communications (AEÜ)*, Elsevier, vol. 62, no. 5, May 2008, pp. 474-385.
18. Andrew Tam, Sazzadur Chowdhury, "Exploiting Sonoluminescence to Realize a MEMS Ultrasonic Sensor", *Journal of Circuits, Systems, and Computers*, vol. 17, no. 2, April 2008, pp. 309-332.
19. Matthew Meloche, Sazzadur Chowdhury, "Design of a MEMS Discretized Hyperbolic Paraboloid Geometry Ultrasonic Sensor Microarray", *IEEE Trans. on Ultrasonics, Ferroelectrics, and Frequency Control*, vol. 55, no. 6, June, 2008, pp. 1362-1372.
20. Wu, Huapeng, "Bit-Parallel Polynomial Basis Multiplier for New Classes of Finite Fields," *IEEE Transactions on Computers*, 57(8), 1023-1031, 2008, Published, August.

(b) Refereed Conference papers

1. J. Li, M. Ahmadi, "Realizing High Throughput Transforms of H.264/AVC," *Proceedings of 2008 IEEE Intern. Symp. On Circuits and Systems*, pp. 840-843, May 2008.
2. M. Mirhassani, M. Ahmadi, G.A. Jullien, "Robust Analog Neural Network Based on

- Continuous Valued Number System” Proceedings of 2008 IEEE Intern. Symp. On Circuits and Systems, May, pp. 1384-1387, 2008.
3. A. Hosseinzadeh-Namin, H. Wu, M. Ahmadi, “A High Speed Word Level Finite Field Multiplier Using Reordered Normal Bases” Proceedings of 2008 IEEE Intern. Symp. On Circuits and Systems, pp. 3278-3281, May 2008.
 4. L. Yang, M. Ahmadi, “A New Motion Estimation Architecture for Block- Matching Algorithm,” to appear in the Proc. of 2008 IEEE Intern. Conf. on Networking, Sensing and Control, Sanya, China, 2008.
 5. A. Nabatchian, E. Abdel-Raheem, M. Ahmadi, “Human Face Recognition Using Different Moment Invariants: A Comparative Study,” Proc. of 2008 International Congress on Image and Signal Processing, Sanya, Hainan, China, pp. 661-666, 27-30 May, 2008.
 6. P. Chang, M. Ahmadi, “On the Use of 4:2 Compressor Cells for Reconfigurable Digital Multiplier Design,” Proceedings of 2008 International Conference on Communications and Electronics, Hoi An, Vietnam, pp. 426-429, June 4-6, 2008.
 7. M.J. Islam, M. Ahmadi, M.A. Sid-Ahmed, “Image Processing Techniques for Quality Inspection of Gelatin Capsules in Pharmaceutical Application,” Proc. of 10th International Conference on Control, Automation, Robotics and Vision (ICARV 2008), Hanoi, Vietnam pp. 862-867, Dec. 2008.
 8. E. Shahinfard, M.A. Sid-Ahmed. M. Ahmadi, “A Motion Adaptive Deinterlacing Method with Hierarchical Motion Detection Algorithm,” Proc. of 2008 IEEE International conference on Image Processing, San Diego Cal., USA, pp. 889-892, Oct. 2008.
 9. I. El-Feghi, M. Galhood, M. A. Sid-Ahmed, M. Ahmadi, “Automated 2-D Cephalometric Analysis of X-ray by Image Registration Approach Based on Least Square Approximator” Proc. of 30th Annual International IEEE-EMBS Conference, Vancouver, BC, Canada, pp. 3949-3952, August 2008.
 10. A. Nabatchian, I. Makaremi, E. Abdel-Raheem, M. Ahmadi, “Pseudo-Zernike Moment Invariants for Recognition of Faces Using Different Classifiers in FERET Database” Proceedings of International Conference on Convergence and Hybrid Information Technology (ICCIT'2008), Bousan, South Korea, pp. 933-936, Nov. 2008.
 11. K. Leboeuf, A. Hosseinzadeh Namin, R. Muscedere, H. Wu, M. Ahmadi, “High Speed VLSI Implementation of the Hyperbolic Tangent Sigmoid Function,” Proceedings of International Conference on Convergence and Hybrid Information Technology (ICCIT'2008), Bousan, South Korea, pp. 1070-1073, Nov. 2008.
 12. S. Alirezaee, M. Ahmadi, A. Alijamat, M.A. Alahiari, “Segmentation of Iranian Checks” Proc. of 12th IEEE International Multitopic Conference, Karachi, Pakistan, pp. 460-462, Dec. 23-24, 2008.
 13. B. Vaseghi, S. Alirezaee, M. Ahmadi, R. Amirfattahi, “Off-line Farsi/Arabic Handwritten Word Recognition Using Vector Quantization and Hidden Markov Model” Proc. of 12th IEEE International Multitopic Conference, Karachi, Pakistan, pp. 575-578, Dec. 23-24, 2008.

14. M. Kiamini, S. Alirezaee, B. Perseh, M. Ahmadi, "A Wavelet Based Algorithm for Ocular Artifact Detection in the EEG Signals," Proc. of 12th IEEE International Multitopic conference, Karachi, Pakistan, pp 165-168, Dec. 23-24, 2008.
15. P. Kalkat, M. Mirhassani, "A Mixed-Signal Adder Based on the Continuous Valued Number System," IEEE Midwest Symposium on Circuits and Systems, pp. 346-349, 2008
16. M. Berhea, C. Chen, and J. Wu, "Protocol-Level Performance Analysis for Anti-Collision Protocols in RFID Systems," in Proc. of the 2008 IEEE International Symposium on Circuits and Systems (ISCAS'08), Seattle, USA, pp. 1008-1011, May 2008.
17. V. Puthucode and C. Chen, "An Experimental Study on Multi-Island Structures for Single-Electron Tunneling Based Threshold Logic," in Proc. of the 2008 IEEE International Symposium on Circuits and Systems (ISCAS'08), Seattle, USA, pp. 600-603, May 2008.
18. Y. Mao and C. Chen, "Modeling Reliability for Single-Electron Tunneling Logic Gates," in Proc. of the 2008 8th IEEE International Conference on Nanotechnology (IEEE-Nano'08), Arlington, Texas, USA, pp. 379-381, August 2008.
19. B. Li and C. Chen, "Design Methodology for Electron-Trap Memory Cells," in Proc. of the 2008 8th IEEE International Conference on Nanotechnology (IEEE-Nano'08), Arlington, Texas, USA, pp. 22-24, August 2008.
20. G. Deng and C. Chen, "Performance Analysis and Improvement for Hybrid CMOS-SET Circuit Architectures," in Proc. of the 1st Microsystems and Nanoelectronics Research Conference (MNRC'08), Ottawa, Canada, pp. 109-112, October 2008.
21. A. Nabatchian, I. Mekaremi, E. Abdel-Raheem, and M. Ahmadi, "Pseudo-Zernike Moment Invariants for Recognition of Faces Using Different Classifiers in FERET Database," Int. Conf. on Convergence and Hybrid Information Tech. (ICCIT), Busan, Korea, pp. 933-936, Nov. 11-13, 2008.
22. A. Nabatchian, E. Abdel-Raheem, and M. Ahmadi, "Human Face Recognition Using Different Moment Invariants: A Comparative Study," Int. Congress on Image and Signal Processing (CISP2008), Sanya, Hainan, China, pp. 661-666, May 2008.
23. S. Erfani, N. Bayan, "Frequency-Domain Realization of Linear Time-Varying Systems by Two-Dimensional Laplace Transformation," Proceedings of IEEE NEWCAS 2008, pp. 213-216, Montreal, Quebec, June 22-25, 2008.
24. S. Erfani, Md. N. Uddin, F. Moro, L. Oriet, and Z. Pasek, "Average Load Distance (ALD) Communication Mode for Wireless Sensor Networks," Proceedings of the 3rd International Symposium on Communications, Control and Signal Processing (ISCCSP 2008), pp. 449-454, St. Julian's, Malta, March 12- 14, 2008
25. Liton Ghosh, Sazzadur Chowdhury, "Electrostatic Energy Characterization for an Atomic Force Microscope Probe", Proceedings of Microsystems and Nanoelectronics Research Conference (MNRC 2008), Ottawa, vol. 1, pp. 1-4.

26. Jose Martinez-Quijada, Sazzadur Chowdhury, "A Two-Stator MEMS Power Generator for Cardiac Pacemakers", Proceedings of IEEE International Symposium on Circuits and Systems 2008 (ISCAS2008), vol.1, 2008, pp.161-164.
27. Ahmad Sinjari, Sazzadur Chowdhury, "Design of a PZT-based MEMS Rotman Lens", Proceedings of Canadian Conference on Electrical and Computer Engineering, CCECE 2008., vol. 1, 2008, pp. 001121 – 001124.
28. Ahmed Sinjari, Sazzadur Chowdhury, "MEMS Automotive Collision Avoidance Radar Beamformer", Proceedings of IEEE International Symposium on Circuits and Systems (ISCAS2008), vol. 1, 2008, pp. 2086-2089.

(c) Papers Presented at Special Workshops and Symposia

1. Ahmad Sinjari, Syed Abbas, Roberto Muscedere, Majid Ahmadi, Sazzadur Chowdhury, "MEMS Sensors for an Integrated Active vehicle Safety System (IAVSS)", North American International Auto Show (NAIAS 2008), Detroit, January 16-17, 2008. (Poster presentation).
2. Ahmed Sinjari, Syed Abbas, Sazzadur Chowdhury, "MEMS Sensors for Automotive Collision Avoidance", OCE Discovery 2008, Toronto, video presentation and Poster, 2008, Published, May, May 12-13, Toronto.
3. Ahmed Sinjari, Syed Abbas, Roberto Muscedere, Majid Ahmadi, Sazzadur Chowdhury, "MEMS Sensors for an Integrated Active vehicle Safety System (IAVSS)", North American International Autoshow (NAIAS), 2008, NAIAS,

II. LIST OF SEMINARS HELD IN 2008

1. **Human Face Recognition**
Mar. 07, 2008
Presenter: Amir Nabatchi
2. **A Delay Generation Technique for Narrow Time Interval Measurement**
Mar. 14, 2008
Presenter: Rashid Rashidzadeh
3. **A Scalable, Full-Custom Memory Design in CMOS 0.18 μm**
Mar. 28, 2008
Presenter: Karl Leboeuf
4. **Leakage tolerant and reliable wide Domino logic design**
Apr. 04, 2008
Presenter: Farhad Haj Ali Asgari
5. **Design of a PZT based MEMS Rotman lenz**
Apr. 11, 2008

Presenter: Ahmad Sinjari

6. 2D Wavelet and its Application

Apr. 18, 2008

Presenter: Iman Makaremi

7. Particle Filters for Colour-Based Face Tracking Under Varying Illumination

Apr. 25, 2008

Presenter: Leila Sabeti

8. Multipliers, Algorithms and Hardware Designs

May 02, 2008

Presenter: Mahzad Azarmehr

9. A High Speed Word Level Finite Field Multiplier Using Reordered Normal Bas

May 09, 2008

Presenter: Ashkan Hosseinzadeh Namin

10. Quality Inspection of Gelatin Capsule in Pharmaceutical Applications

May 16, 2008

Presenter: Mohammed Islam

11. Protocol-level Performance Analysis and Implementation for Anti-collision Protocols in RFID Systems

May 30, 2008

Presenter: Mohammed Nuru Berhea

12. A DRAM for CVNS

Jun. 13, 2008

Presenter: Golnar Khodabandehloo

13. High Level Device Design: A Custom Digital Camera

Jun. 20, 2008

Presenter: Anthony Karloff

14. An Introduction to Universal Serial Bus

Jun. 27, 2008

Presenter: Neil Scott

15. Smart RFID for Location Tracking

Jul. 11, 2008

Presenter: Rashid Rashidzadeh

16. Circuit techniques for overcoming contention current in wide domino logic gates

Jul. 18, 2008

Presenter: Farhad Haj Ali Asgari

17. 4:2 Compressor Cells Design Based on Domino Logic

Aug. 01, 2008

Presenter: Chang Peng

- 18. 3D Face Recognition, Approaches and Challenges**
Aug. 15, 2008
Presenter: Amirhosein Nabatchian
- 19. UWindsor Nios II: A Soft-core Processor for Design Space Exploration**
Aug. 22, 2008
Presenter: Omar Al Rayahi
- 20. An Efficient Wavelet Based Feature Extraction Method with Application in Face Recognition**
Sep. 05, 2008
Presenter: Iman Makaremi
- 21. NoC Design & Implementation on FPGA for Multispectral Image Processing application**
Sep. 12, 2008
Presenter: Linlin Zhang
- 22. Performance Analysis and Improvement for Hybrid CMOS-SET Circuit Architectures**
Oct. 17, 2008
Presenter: Guoqing Deng
- 23. High Speed VLSI Implementation of the Hyperbolic Tangent Sigmoid Function**
Oct. 24, 2008
Presenter: Karl Leboeuf
- 24. Power-Management-Based Chien Search for Low Power BCH Decoder**
Oct. 31, 2008
Presenter: Jack Wong
- 25. Joint Iterative Equalization, Demapping and Decoding for 5.9 GHz DSRC applications**
Nov. 21, 2008
Presenter: Nabih Jaber
- 26. Efficient thresholding technique using Neural Networks**
Nov. 28, 2008
Presenter: Mohammed Islam

III. AWARDS AND HONOURS

Dr. M. Ahmadi received University of Windsor Faculty of Engineering Dean's Special Recognition Award, 2008

Dr. S. Chowdhury received the award for Excellence in Scholarship, Research and Creative Activity, 2008

IV. GRANTS AND CONTRACTS RECEIVED BY THE RCIM MEMBERS

1. M. Ahmadi and 2 others , A Computer Vision-Based Quality Process Controller for Pharmaceutical Products OCE project with support from MMO, NSERC and Pharmaphil of Windsor, Ontario, **\$84,500**,
2. Dr. M.Ahmadi individual NSERC Discovery Grant, **\$58,250**.
3. Dr. G.A. Jullien, Dr. M.Ahmadi, and three others NSERC- Collaborative Research and Development (CRD) Grant, **\$30000 of \$93000** .
4. Dr. C. Chen, NSERC Discovery Grant **\$20,000**
5. Dr. C. Chen, AUTO21, **\$19,000**
6. Dr. C. Chen and Dr. O'Leary, NSERC-RTI grant **\$42,900**
7. Dr. S.K. O'Leary NSERC Discovery Grant Amount: **\$24,300**
8. Dr. E. Abdel-Raheem, NSERC Discovery Grant **\$13000**
9. Dr. M. Khalid, NSERC Discovery Grant **\$20,000**
10. Dr. S. Chowdhury, NSERC Discovery Grant **\$38,500**
11. Dr. S. Chowdhury, Ontario Centres of Excellence, Automotive Champions of Innovation grant, **\$199,935**
12. Dr. R. Muscedere, NSERC Discovery Grant **\$17,000**
13. Dr. Huapeng Wu, NSERC Discovery Grant **\$10,000**
14. Dr. Mirhassani, University of Windsor startup research grant. **\$30,000**
15. In-Kind support of **\$210,030** per year from IntelliSense Software Inc. towards the license of their MEMS CAD tools
16. CMC Microsystems contributions to RCIM totaled **\$669,000** for the 2008. The breakdown of the funding is as follows:

Support, Design Kits, Training	\$235,000
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Material, Tutorials	
Fabrication	\$106,000
Microsystems CAD Tools	\$328,000
Total	\$669,000

Total Grants received by RCIM members for 2007-2008: \$1,486,415.

V. GRADUATE COURSES TAUGHT BY RCIM MEMBERS

1. Dr. S. Erfani 06-88-557: Network Security
2. Dr. S. Erfani 06-88-523: System Theory
3. Dr. M. Ahmadi 06-88-521 Digital Signal Processing
4. Dr. M. Ahmadi 06-88-590 Motion Estimation
5. Dr. E. Abdel-Raheem 06-88-551: Advanced Digital Signal Processing
6. Dr. E. Abdel-Raheem 88-562: VLSI Implementation of DSP Systems
7. Dr. M. Khalid 06-88-560: Reconfigurable Computing
8. Dr. M. Khalid 06-88-590: Physical Design Automation for VLSI and FPGAs
9. Dr. R. Muscedere 06-88-531: VLSI Design
10. Dr. C. Chen 06-88-541: Low Power CMOS Design
11. Dr. C. Chen 06-88-590-43: Introduction to Nanoelectronic Design
12. Dr. H. Wu 06-88-555: Computer Arithmetic
13. Dr. H. Wu 06-88-529: Discrete Transforms & Number Theoretical
14. Dr. S. Chowdhury 06-88-552: Advanced Topics in MEMS
15. Dr. Rashidzadeh 06-88-590-37: Advanced Analog Circuit Design
16. Dr. Rashidzadeh 06-88-590-74: RF Integrated Circuit Design
17. Dr. M. Ahmadi 06-88-525: 2-Dimensional Digital Signal Processing
18. Dr. M. Mirhassani 06-88-590-47: Analog IC mask design
19. Dr. S. O'leary 06-88-590-42: Electronic Materials and Devices

VI. COLLABORATIVE RESEARCH WITH THE PRIVATE SECTOR

Gennum Corporation , 970 Fraser Drive, Burlington, Ontario L7L 5P5

Principal Investigator: Dr. G.A. Jullien/ Dr. M. Ahmadi,

Project: Integrated Systems for High Performance Signal Processing. NSERC-CRD with industrial support from Gennum

Pharmaphil , 3190 Devon Rd , Windsor, Ontario N8X 4L2

Principal Investigator: Dr. M. Ahmadi, Co-PIs, Dr. R. Muscedere, Dr. W. Abul-Kader

Project: A Computer Vision-Based Quality Process Controller for Pharmaceutical Products OCE project with support from MMO, NSERC and Pharmaphil of Windsor, Ontario

Canadian Bank Note Company, 145 Richmond Rd Ottawa, ON, K1Z 1A1

Principal Investigator: Dr. M. Ahmadi

Project: FD- Document Authentication. Contract Research

IntelliSense Software Inc. 600 West Cummings Park, Suite 2000, Woburn, MA,

Project: Collaborative research partnership. In-Kind support of \$210,030 per annum

Principal Investigator: Dr. S. Chowdhury

CMC Microsystems Corporation, 210A Carruthers Hall, Kingston, Ontario, Canada K7L 3N6

Principal Investigators: M.Ahmadi, C. Chen, W.C. Miller, .S. Chowdhury, . R. Muscedere, M. Khalid, Mitra Mirhassani, R. Rashidzadeh

Project: System-on-Chip (SoC) Design Methodology, Authoring IP Cores

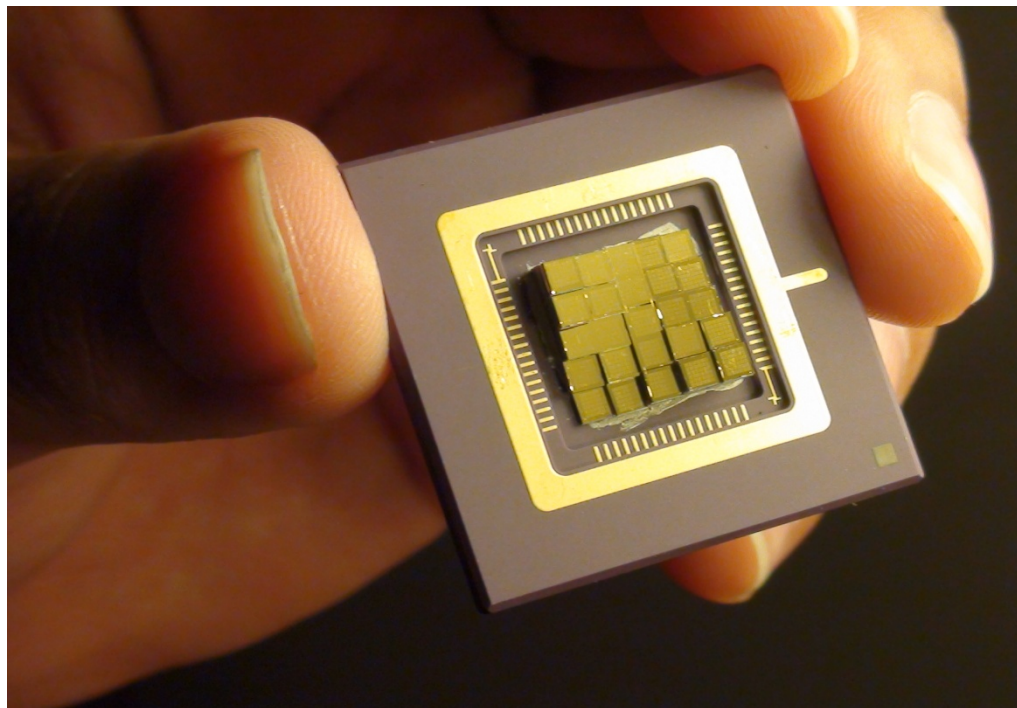
Jean Monnet University, France

Dr. Khalid is involved in collaborative research with Prof. Virginie Fresse of Hubert Curien Laboratory, Jean Monnet University, St. Etienne, France. A PhD students (Ms. Linlin Zhang) from this institution was a visiting scholar in RCIM for a period of six months (March to September 2008) working under the supervision of Dr. Khalid. She conducted research in exploring NoC architectures for multispectral image processing applications, implemented on FPGAs.

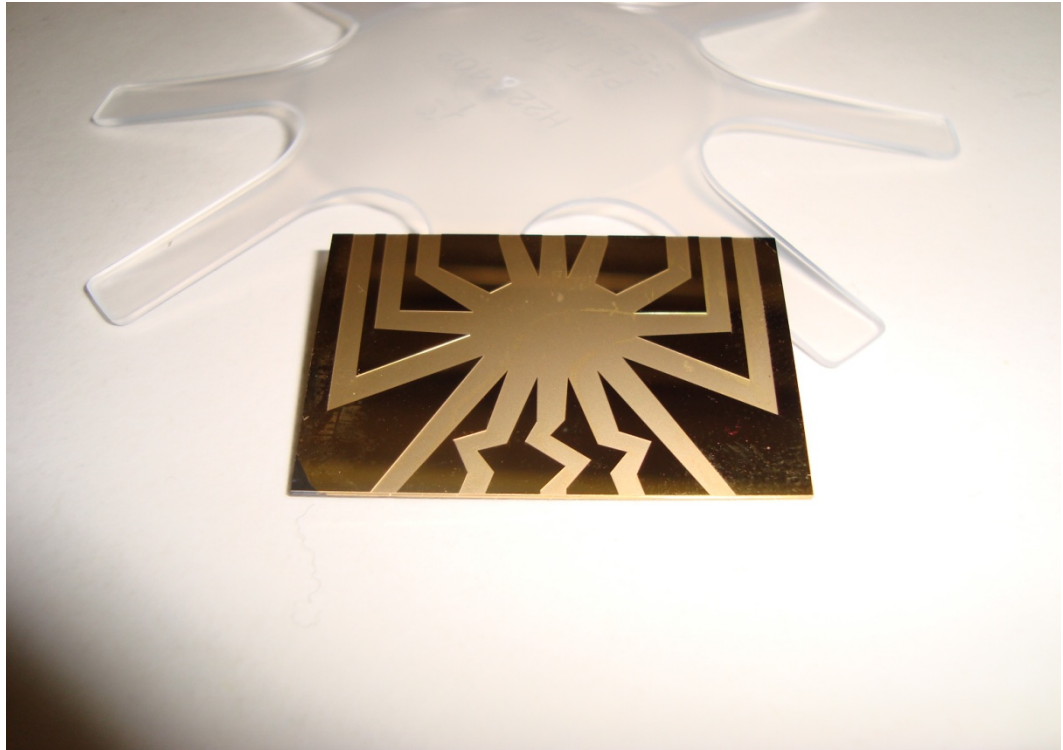
VII. PHOTOGRAPHS



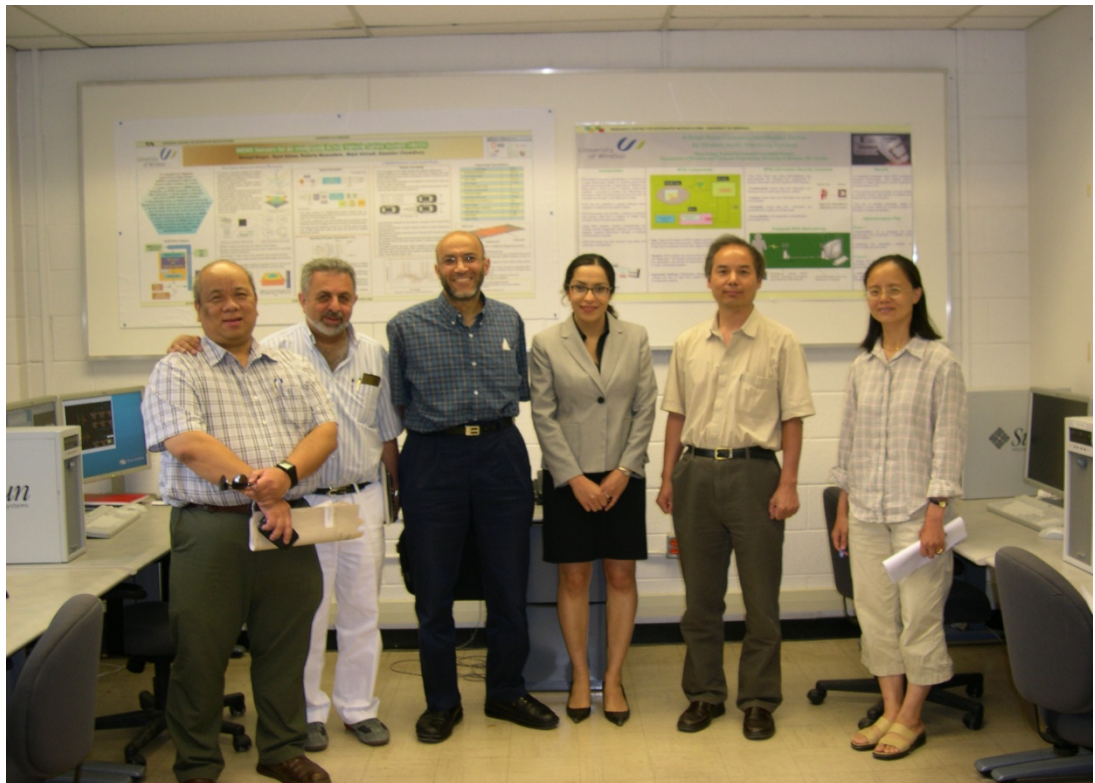
Mr. Syed Yasir Abbas, M.A.SC. student, using clean room facility at the University of Waterloo to fabricate a Non-planar Array for Automotive Blindspot Detection.



Prototype of the Non-planar Array fabricated for Automotive Blindspot Detection



Prototype of a MEMS beam former designed by Mr. A. Sinjari under supervision of Dr. S. Chowdhury for Automotive Collision Avoidance System.



Dr. Elham Shahinfar (third from right) successfully completes her Ph.D. thesis defense. Dr. Mahmoud R. El-Sakka, University of Western Ontario (third from left) was the external examiner.

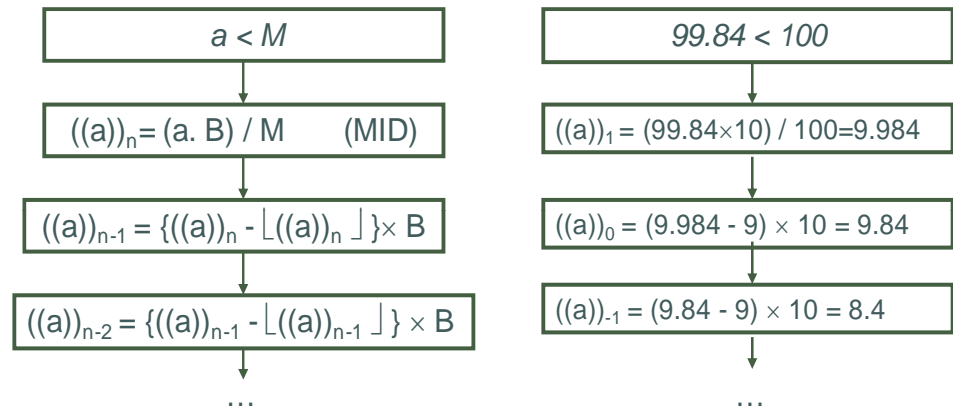


**RCIM Director, Dr. M. Ahmadi, presenting the results
of his research in China**

A Multi-Level Memory Based on CVNS

Golnar Khodabandehloo, Ph.D. Candidate
Supervisors: Dr. M. Ahmadi, Dr. M. Mirhassani

This multi-level current mode DRAM can store up to 4-bit (16-level) on each storage cell. It will increase the bit-per-cell storage capacity. Refreshing circuitry is designed based on Continuous Valued Number System (CVNS) resulting in higher noise margin for the memory. With series configuration of ADC and DAC, it restores the correct value on the storage capacitor after each refreshing cycle. The circuit is designed and simulated using 90nm CMOS technology.

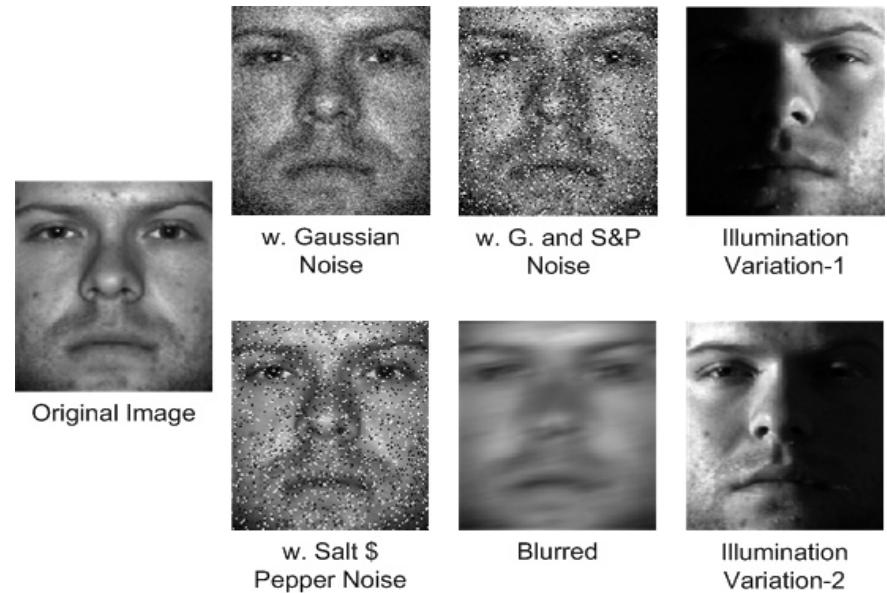


Digit Generation in CVNS

Automatic Face Recognition Under Distortive Circumstances

Iman Makaremi, Ph.D. Student
Supervisor: Dr. M. Ahmadi

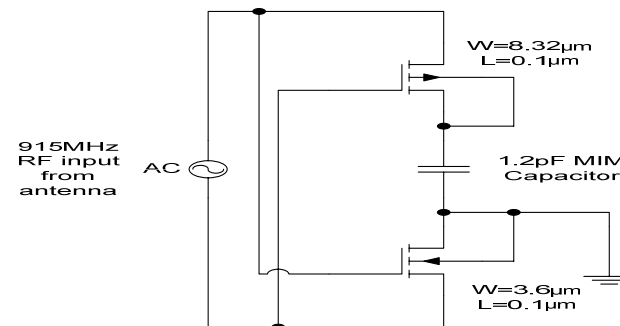
We are trying to come up with approaches for face recognition that are robust to different kinds of degradation on face images. Noise (salt and pepper, Gaussian, and both), blurriness, illumination variation (uniform and non-uniform) are the main challenges we are tackling in this project. Our effort is basically focused on developing feature extraction methods that have the least sensitivity to these deteriorations.



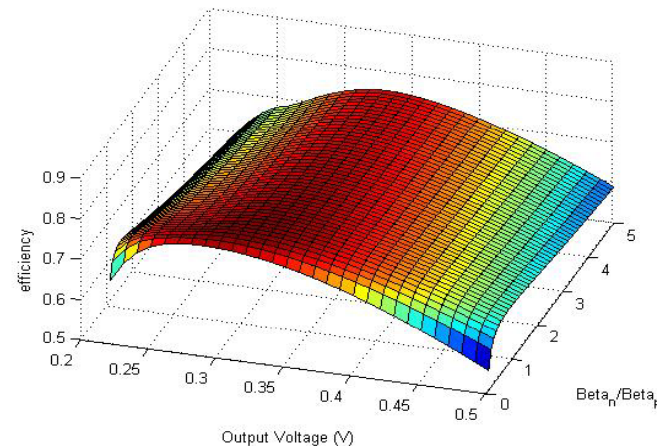
CMOS 90nm Low-Power Rectifier Design for RFID Tags

Shu-Yi Wong, M.A.Sc. Student
Supervisors: Dr. C. Chen, Dr. J. Wu

A Passive RFID tag obtains its power from the rectifier circuit, which harvests energy from the ambient RF field. High power conversion efficiency (POE) is vital but convention methods only offers a maximum POE of 37%. This research shows how and where (see bottom right-hand side) a POE of 74% can be obtained from CMOS bridge-rectifier (top), leading to a solution for difficult-to-meet RFID operating conditions.



Half-bridge Rectifier

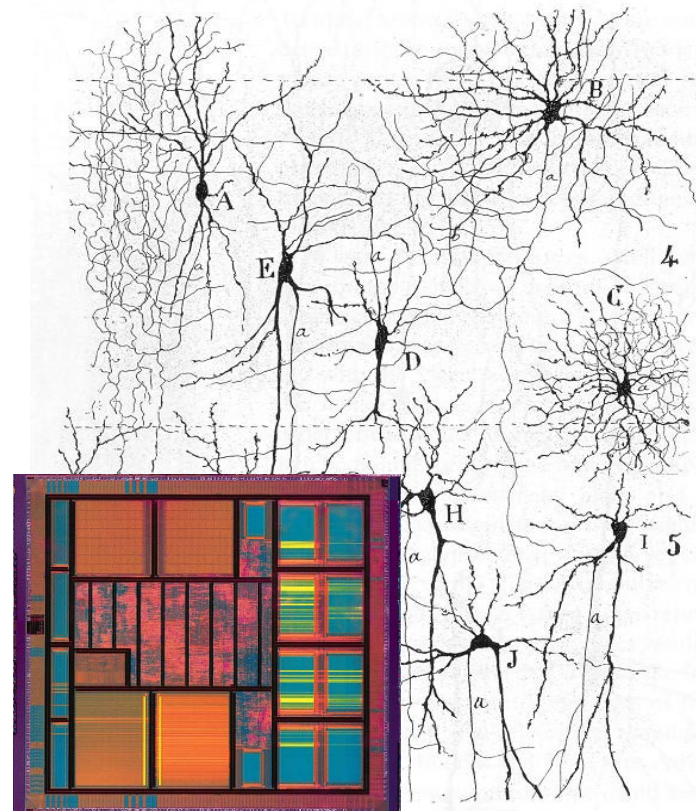


A High Speed, High Density, and Scalable Digital Artificial Neural Network Architecture

Karl Leboeuf, Ph.D. Candidate

Supervisors: Dr. M. Ahmadi, Dr. R. Muscedere

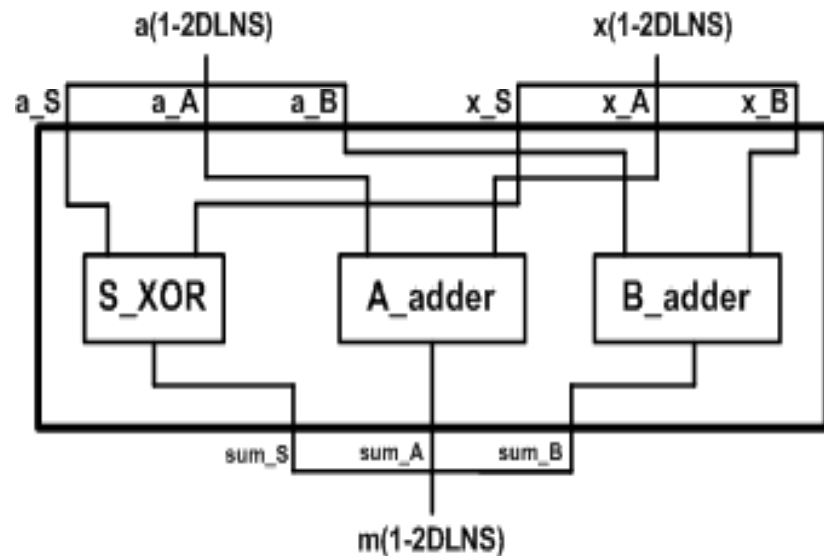
The Artificial Neural Network (ANN) is a type of computer architecture that was inspired by the biological brain, and excels at performing certain tasks such as voice recognition and stock market prediction. Unlike traditional computers, it consists of many simple processing elements, rather than a single, large central processing unit. A drawback to ANNs is that they perform slowly in software, rendering them unsuitable for use in embedded devices. The aim of this research is to design a small, fast, and efficient ANN architecture that is scalable, enabling their use on embedded systems and large-scale computing engines alike.



Reconfigurable Logarithmic-based DSP Architectures

Mahzad Azarmehr, Ph.D. Candidate
Supervisors: Dr. M. Ahmadi, Dr. G. Jullien

The main focus of this research is design and implementation of reconfigurable hardware architectures to realize some digital signal processors. These architectures benefit from Multi-Dimensional Logarithmic Number System (MDLNS) arithmetic. In these applications, reconfigurable architectures have been emerged to provide a flexible, high-performance and low-power implementation platform for wireless embedded devices. These architectures benefit from different level of recursion in a recursive 2DLNS-based multiplication scheme.

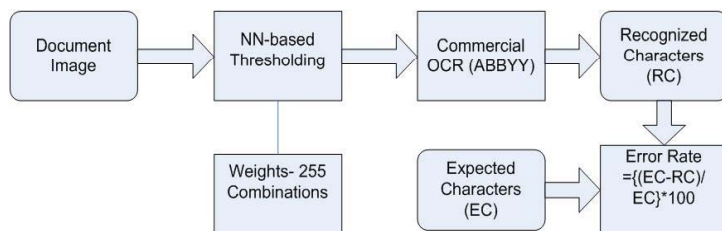


1-digit 2DLNS Multiplication

Selection of Optimal Parameters in Neural Network Based Local Thresholding Techniques in Document Recognition Applications

Mohammed J. Islam, Ph.D. Student

Supervisors: Dr. M. Ahmadi, Dr. M.A. Sid-Ahmed



Flowchart: Test Setup

Techniques	Tested Chars	Recognition Rate (%)
Proposed, 3 features	15000	99.25
ABBY	14600	96
Alginahi, 8 features	14600	98
Alginahi, 5 features	Not mentioned	98.3

Table: Performance comparison of the proposed features

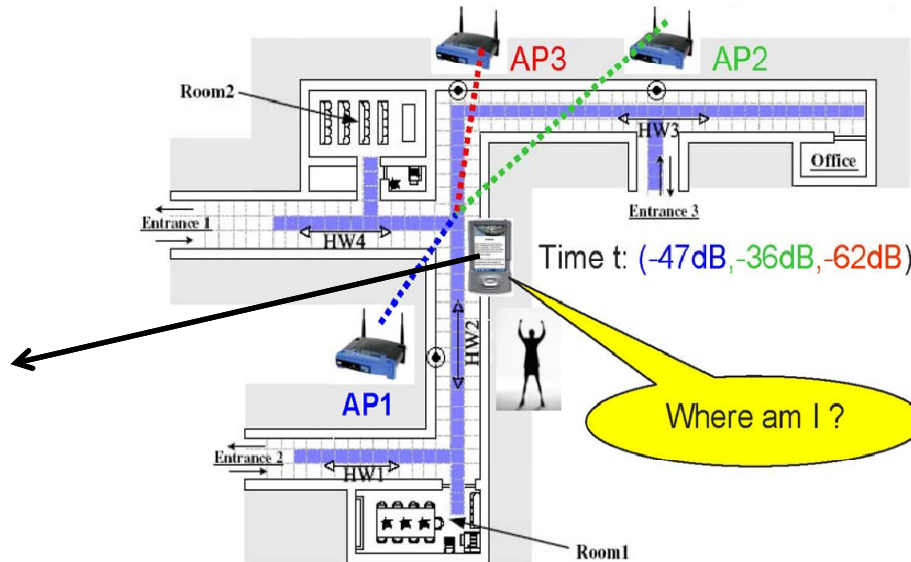
Thresholding of a given image into binary image is a necessary step for most image analysis and recognition techniques. Non-uniform illumination, low contrast and complex background make it challenging in document recognition application. The objective of the research is to select the optimal parameters for Neural Network (NN) based local thresholding approach for thresholding the grey scale composite document image with non-uniform background.

Indoor Location Tracking Using RF Signal Strength in WLAN Networks

Ning Chang, Ph.D. Student

Supervisors: Dr. M. Ahmadi, Dr. R. Rashidzadeh

The strength of the Wi-Fi signals received from different access points is used as a signature to determine the location of a user. The architecture of Wi-Fi Location Positioning System is shown in the figure.

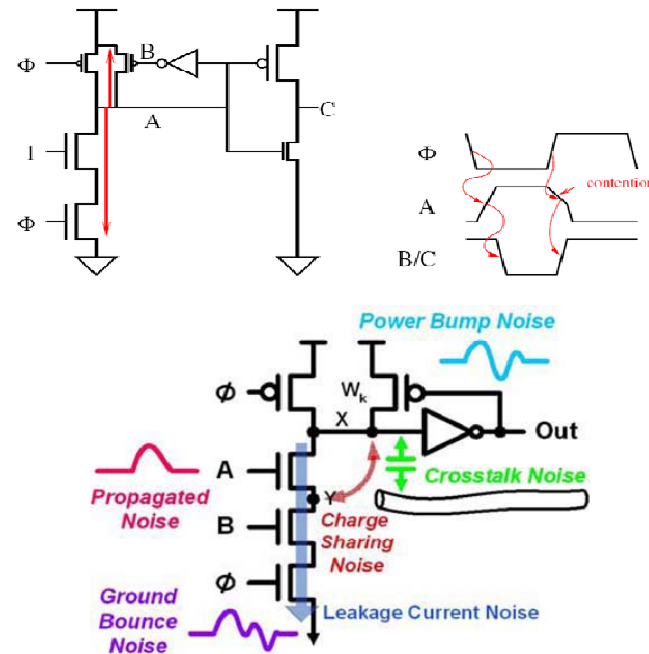


Indoor Localization system

Leakage Control Techniques for Fast, Low-Power Domino Logic Gates

Farhad Haj Ali Asgari, Ph.D. Candidate
Supervisors: Dr. M. Ahmadi, Dr. J. Wu

Dynamic circuits have applications in high-performance microprocessors where custom design helps to get faster circuits. In deep sub-micron technology nodes, leakage current and contention are increasingly deteriorating the noise performance of these circuits in general, and the power consumption for portable applications in special application. This project is investigating novel methods to improve the performance of domino logic gates with applications in fast memory address decoders and high performance arithmetic logic units.

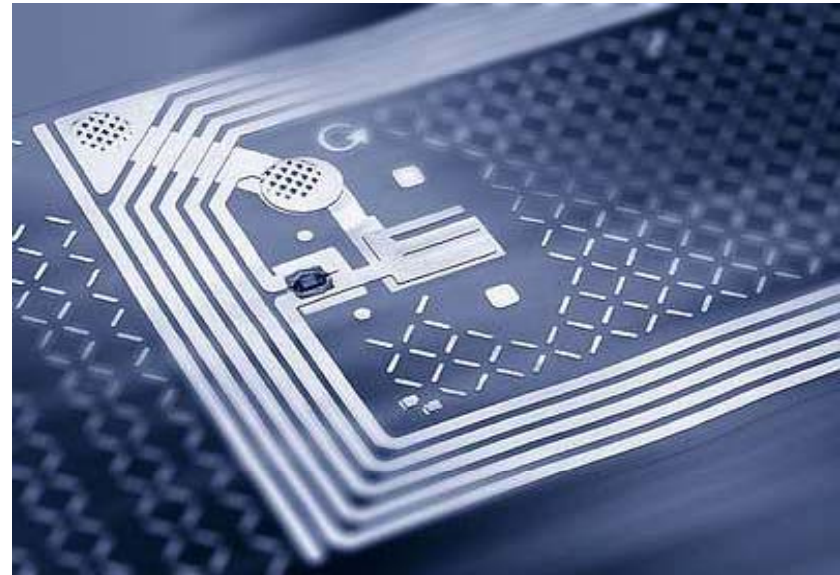


Contention and Noise Sources
in Domino Logic

Ultra Low Power Clock Generator for Passive UHF RFID Tags

Suzana Farzeen, M.A.Sc. Student
Supervisor: Dr. C. Chen

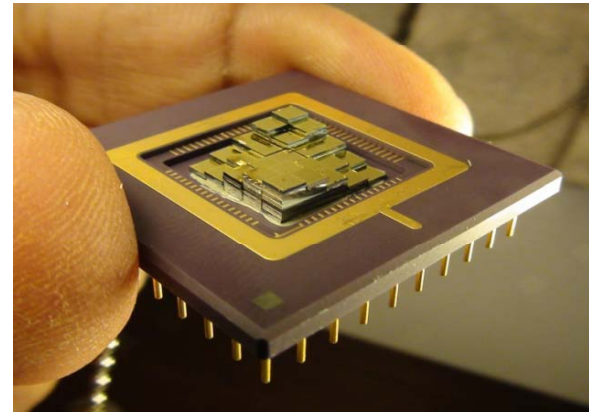
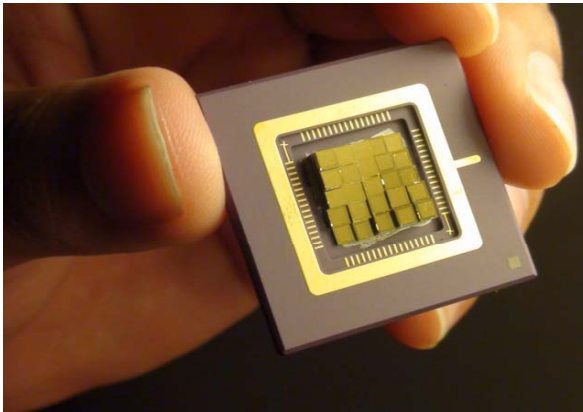
A clock generator is used to generate the system clock for the baseband processor of the RFID tag. Passive UHF RFID tags need to draw the power from a weak RF signal transmitted by the reader and only few μW power can be obtained to achieve several meters of operating range. A ring oscillator is adopted as the clock generator to ensure low power operation and meet the area and cost requirement of the system.



RFID Tag

A MEMS Non-Planar Ultrasonic Sensor Array

Syed Abbas, M.A.Sc. Candidate
Supervisor: Dr. S. Chowdhury



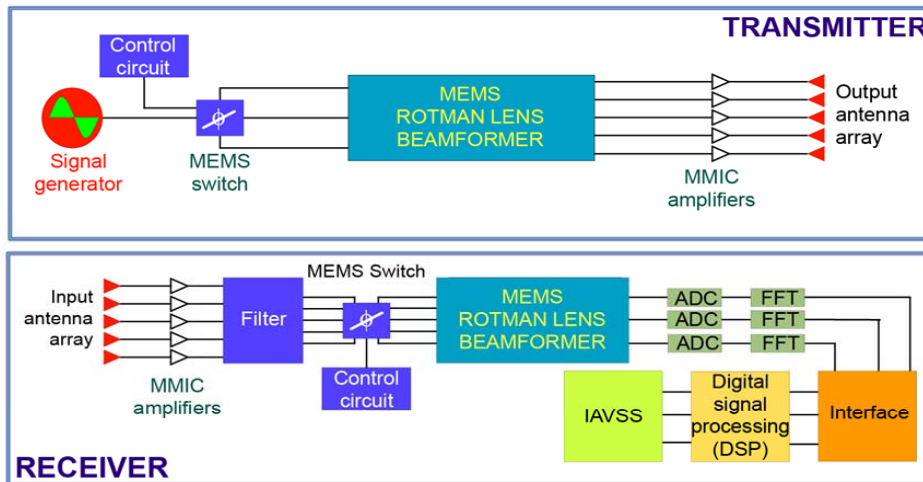
Ultrasonic Sensor Array Chip Photos

- The device is a MEMS based non-planar ultrasonic sensor array which is designed for automotive blindspot monitoring application.
- The non-planar array has a foot print area of 9 mm² that houses 900 tiny square diaphragm MEMS ultrasonic sensors in 7 different elevations.
- Mounted on the sideview mirrors, the array will be able to provide a visual or acoustical signal to warn the driver if a lane change maneuver is safe or not.
- The device can also be used for rear end park assist or for seat occupancy detection.

A MEMS Based Radar Sensor for Automotive Collision Avoidance

Ahmad Sinjari, Ph.D. Student
Supervisor: Dr. S. Chowdhury

System Description



Rotman Lens Die Photo

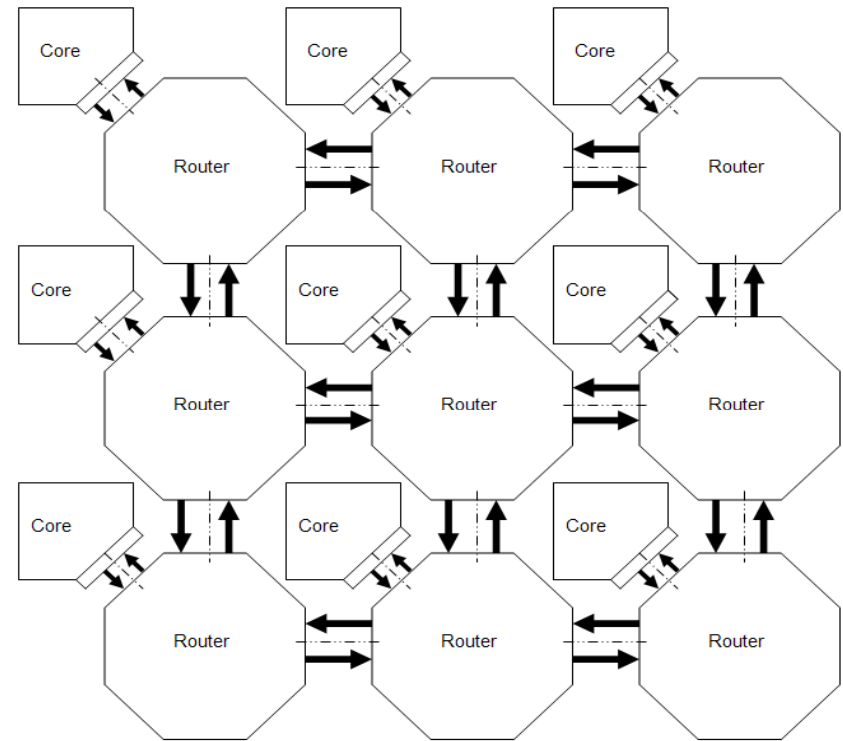
The system foot print area is about 2.5 x 1.0 inches square before packaging.

- Development of a MEMS based long range (150-200m) radar sensor operating at 77 GHz for an automotive collision avoidance system is in progress.
- This relatively simpler device enables a high reliability solid state directional scan-and-range system where a narrow radar beam is steered using a MEMS Rotman lens and RF switch combination to scan the target area.
- Major components of the system include: a MEMS RF switch, a MEMS Rotman lens and a MEMS microstrip antenna array that are to be packaged as a single unit.

Implementation and Evaluation of an NoC Architecture for FPGAs

Thuan Le, , M.A.Sc. Student
Supervisor: Dr. M. Khalid

- Inspired by Network Theory and data communication networks, NoC is gaining support as the system-wide communication resource.
- NoC presents a leverage between increasing system complexity, strict design cycle time requirements and achieving maximum flexibility and scalability
 - Wires become pipelines
 - Bus-bridges become routing nodes
- Therefore, a shared, segmented global wire communication structure will quickly be seen as a data-routing network consisting of communication links and routing nodes
- NoC scales well with the increase of chip size and complexity



Proposed NoC Architecture

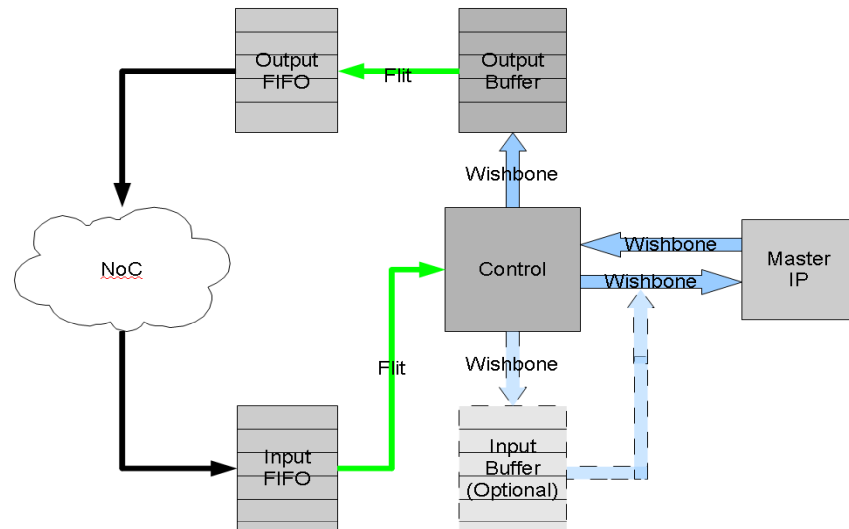
A VHDL Template Library for NoC Implementation on FPGAs

Matt Murawski, M.A.Sc Student
Supervisor: Dr. M.A.S. Khalid



The goal of this research is to develop a library of components for Network-on-Chip experiments, targeting FPGA applications using VHDL. The network interface adapter is Wishbone compatible in order to use Opencore.org's open-source IP core library. The adapter supports a high-speed burst transfer system as well as parameterizable components, which offers flexibility and compatibility for the designer.

The NoC is a packet switched, store-and-forward architecture.



Network Adapter for Wishbone
SoC Interconnection Architecture

A CAD Tool for Synthesizing Optimized Variants of Altera's NIOS II Soft-Core Processor

Omar Al Rayahi , M.A.Sc. Student
Supervisor: Dr. M. Khalid

Parameterized soft-core processors can have thousands of possible configurations in their design space. However, not all configurations are optimal for a specific application. Therefore, it's important for embedded system designers to choose a well-optimized configuration for their system.

Because of the large number of possible configurations, manual exploration of design space is not practical; the exploration process needs to be automated. A genetic algorithm (SEAMO genetic algorithm) is used to automate this process; it removes non-optimal configurations and returns a list of the most optimal ones, from which designers can choose the most suitable configuration for their system.

